WATER RESOURCES RESEARCH GRANT PROPOSAL

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Abstract

A. Problem

Riparian areas are buffers between terrestrial and stream ecosystems, maintaining water quality for healthy ecosystems and human communities. Resh et al. (1988) suggest that ecologically diverse riparian corridors are maintained by an active natural disturbance regime, defining disturbance as an event characterized by frequency and intensity outside a predictable range that disrupts ecosystem structure and changes resources or the physical environment (function). Although flooding is considered the most common disturbance for riparian systems, another is fire (Brock and Varley 1989; Minshall et al. 1998; Ewing 1996). With continuing drought conditions in the western U.S., there may be reduced flooding while the risk of wildfires is expected to increase (Balling et al 1992; Millspaugh et al. 2000). The recovery of stream and riparian systems after fire is related to the resiliency of the system. Resilience has been defined as “the magnitude of disturbance that can be tolerated before an ecological system moves to a different region of state space controlled by a different set of processes” (Carpenter et al. 2001), in other words, some level of resistance to disturbance leading to recovery or lack of recovery.

Resiliency relates to the return of both structure and function following disturbance. There is a notable lack of information on the resiliency of riparian functions to fire perturbation.

Because of their direct role of riparian ecosystems in protecting water quality, riparian forest management has recently become a primary concern for forests managers. Managers have generally focused on maintaining riparian zones as late successional forests, with the goal of protecting aquatic habitats (USDA 2004). A century of fire suppression has resulted in increased fuel loads in western forests, increasing the possibility of intense catastrophic fires. Current forest management policy promotes controlled burning to reduce fuel loads. Although the literature indicates that riparian areas have a natural fire frequency, which is disrupted by fire suppression (Olson 2000; Everett 2003; Skinner 2003), riparian areas are generally excluded from burn prescriptions (Montana DNRC 1995; USDA 2004). This approach to riparian management raises questions about the ability of riparian forests to function as buffers in an exclusively late successional state, maintained by systematic fire suppression.

Several studies have investigated the resiliency of stream ecosystems to fire (Minshall and Robinson 1993; Minshall et al. 1998; Minshall et al. 1989; Ewing 1996; Spencer and Hauer 1991; Resh et al 1988), while few studies have investigated the resiliency of riparian ecosystems. Studies related to the short-term resiliency of riparian ecosystems indicate that: (a) fire promotes increased regeneration of cottonwoods and willows by stimulating clonal sprouting (Gom 1999; Ellis 2001; Rood et al. 1998); (b) fire can promote increased seedling reproduction of riparian species by removing competing species, and opening up the canopy (Wolf 2004), (c) sediment delivery increases directly after a fire, entering streams with overland flow, and declines as riparian vegetation recolonizes, and buffering functions return (Lawrence and Minshall 1994; Minshall et al. 1998; Ewing 1996), and (d) nutrient delivery increases during fire, with nitrogen and phosphorous entering streams through smoke and ash fallout respectively, and with overland and groundwater transport during post-fire precipitation events. Nutrient delivery declines fairly rapidly as vegetation returns and nutrients are sequestered, generally within a few months to a year (Spencer and Hauer 1991; Minshall et al. 2001; Wan et al. 2001). Studies focused on the long-term resiliency of riparian vegetation to fire have demonstrated a transition in riparian zone vegetation from a deciduous, shrub/forb/grass dominated community to a late successional coniferous forest with less understory cover, related to time since burning (10-300 years) (Lawrence and Minshall 1994). My proposed study is unique in that it addresses the long-term resiliency of riparian functions to fire in addition to short-term responses and resiliency of riparian systems.